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Indian Standard

TRANSMISSION DEVICES — FLEXIBLE COUPLINGS — TYRE TYPE — SPECIFICATION

UDC 621·825·6

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

December 1995

Price Group 5

Transmission Devices Sectional Committee, LM 10

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Transmission Devices Sectional Committee had been approved by the Light Mechanical Engineering Division Council.

Tyre type flexible couplings are used to: (i) transmit power, (ii) accommodate misalignment, and (iii) compensate for end movement. These couplings have wide application for connecting two shaft ends. The standard, besides specifying various requirements, gives guidelines for coupling design, selection and example of calculation of performance characteristics, which are given in Annex A.

The information given in Annex A is based on DIN 740 (Part 2) 'Flexible shaft couplings parameters and design principles', issued by the Deutsches Institut für Normung (DIN), Germany.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

TRANSMISSION DEVICES — FLEXIBLE COUPLINGS — TYRE TYPE — SPECIFICATION

1 SCOPE

1.1 This standard covers the requirements of tyre type flexible couplings used for connecting two shaft ends.

1.2 This standard does not include tyre type couplings of special types like floating shaft, brake drum and pulley mounted.

1.3 This standard is meant to be used for general applications only and not to be used for special applications such as under fire hazardous situations.

2 REFERENCES

The following Indian Standards are necessary adjuncts to this standard:

IS No.	*Title*
210 : 1993	Grey iron castings (*fourth revision*)
1030 : 1989	Carbon steel castings for general engineering purposes (*fourth revision*) (Amendment No. 1)
1364	Hexagon head bolts, screws and nuts of product grades A and B
(Part 1) : 1992	Hexagon head bolts (size range M1·6 to M64) (*third revision*)
(Part 2) : 1992	Hexagon screws bolts (size range M1.6 to M64) (*third revision*)
(Part 3) : 1992	Hexagon nuts bolts (size range M1.6 to M64) (*third revision*)
1367 (Part 3) : 1991	Fasteners — Threaded steel — Technical supply conditions : Part 3 Mechanical properties and test methods for bolts, screws and studs with full loadability (*third revision*)
1570 (Part 2/Sec 1) : 1979	Schedules for wrought steels : Part 2 Carbon steels (unalloyed steels), Section 1 Wrought products (other than wire) with specified chemical composition and related properties (*first revision*)
1885 : 1991	Iron castings with spheriodal or nodular graphite (*second revision*)
2102 (Part 1) : 1993	General tolerances : Part 1 Tolerances for linear and angular dimensions without individual tolerance indications (*third revision*)
2269 : 1981	Hexagon socket head cap screws (*second revision*) (Reaffirmed 1991)
3400 (Part 6) : 1983	Methods of test for vulcanized rubbers : Part 6 Resistance to liquids (*first revision*) (Reaffirmed 1990)

3 TERMINOLOGY

3.0 For the purpose of this standard the following definition/explanation of terms shall apply.

3.1 Nominal Torque (T_{KN})

Torque that can be continuously transmitted across the entire permissible rotational speed range.

3.2 Maximum Torque ($T_{K\max}$)

Torque resulting from pulsating or alternating stresses, which a coupling can resist without failure for a short period of time.

3.3 Alternating Torque (T_{Wi})

Amplitude of permissible continuous periodic torque fluctuations, at frequency of 10 Hz and base torque of T.

3.4 Torsional Stiffness (C_T)

First derivative of coupling torque with respect to angle of torsion.

3.5 Damping Coefficient (ψ)

A hysteresis loop is plotted between the torque applied and the angle of torsion (measured in radians) of one half of coupling relative to the other and the coefficient is calculated as:

$$\frac{\text{Loop area}}{\text{Torque applied}} \times \frac{\text{Angular deflection}}{2}$$

3.6 Resonance Factor (V_R)

The resonance factor is calculated as:

$$V_R = \frac{2\pi}{\psi}$$

3.7 Frequency Coefficient (F)

Coefficient that makes allowance for frequency dependence of the fatigue torque:

For frequency $f \leqslant 10$ Hz $\quad F = 1.$
For frequency $f > 10$ Hz $\quad F = \sqrt{f/10}$

3.8 Starting Coefficient (S_Z)

Coefficient that makes allowance for loading caused by the frequency of starts, Z, as follows:

Z (per h)	S_Z
Up to and including 120	1·0
Above 120 up to and including 240	1·3
Above 240	Consult manufacturer

3.9 Temperature Coefficient (S_T)

Coefficient that makes allowance for the decrease in strength of elastic rubber materials when exposed to heat, in particular to the effect of radiant heat, if any.

t	S_T		
°C	Natural Rubber (NR)	Polyurethane Elastomers (PUR)	Acrylonitrile Butadiene (NBR)
$-20 < t \leqslant 30$	1·0	1·0	1·0
$30 < t \leqslant 40$	1·1	1·2	1·0
$40 < t \leqslant 60$	1·4	1·4	1·0
$60 < t \leqslant 80$	1·6	1·8	1·2

4 RATING AND DIMENSIONS

4.1 The rating and dimensions of the couplings shall be as specified in Table 1.

4.2 The dimensions of the tyres shall be as given in Table 2.

5 MATERIAL

The materials for the component parts of the tyre type flexible couplings shall be as specified in Table 3.

6 PHYSICAL PROPERTIES

The physical properties of the tyres shall be as given in Table 4.

7 DESIGNATION

7.1 The tyre type coupling shall be designated by specification No., the overall tyre diameter along with the prefix TC (*see* Table 1).

For example, a tyre type coupling having an overall tyre diameter of 254 mm shall be designated as:

Tyre type coupling IS 14285 TC 254

8 GENERAL REQUIREMENTS

8.1 The hubs shall be free from blow holes and cracks. They shall be machined all over for proper balancing.

8.2 The tyre shall have high degree of surface finish in the outside surface and shall be free from flashes, cuts and other damages.

8.3 The pressure discs which grip the tyre shall be replaceable for couplings TC 359 to TC 628.

NOTE — For couplings with rating TC 359 and above, the construction is different in view of increased transmission capacity and as such calls for replaceable discs.

8.4 Unless otherwise specified, all dimensional tolerances shall be as specified in IS 2102 (Part 1) : 1993.

8.5 Tyre fixing screws shall not become loose while in service.

9 MARKING

9.1 The couplings shall be marked with the following:

a) Coupling designation, and

b) Year of manufacture.

9.2 BIS Certification Marking

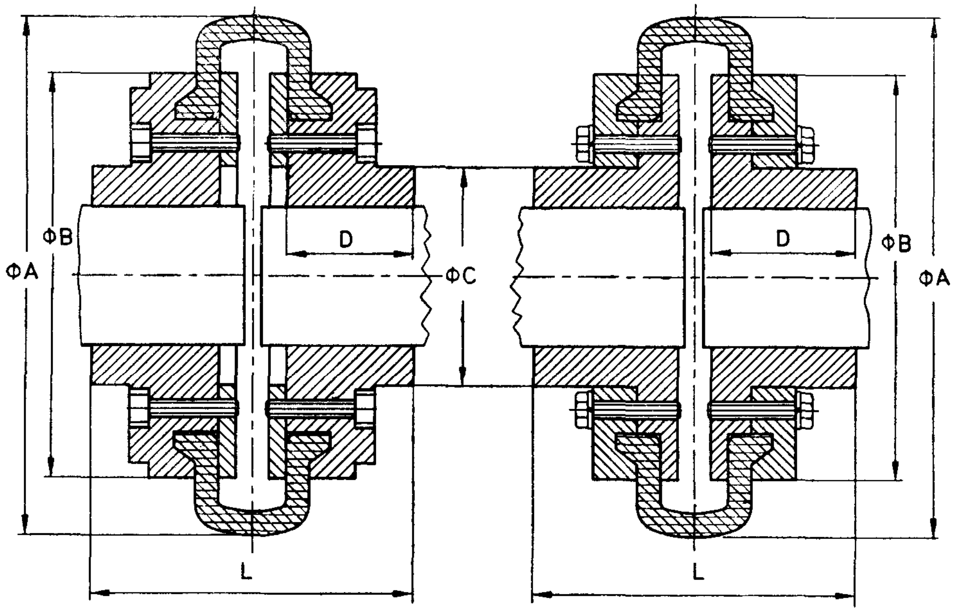
The product may also be marked with the Standard Mark.

9.2.1 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act*, 1986 and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

Table 1 Rating and Dimensions of the Couplings

(*Clause* 4.1)

All dimensions in millimetres.



COUPLING DESIGNATION TC 104 TO 314

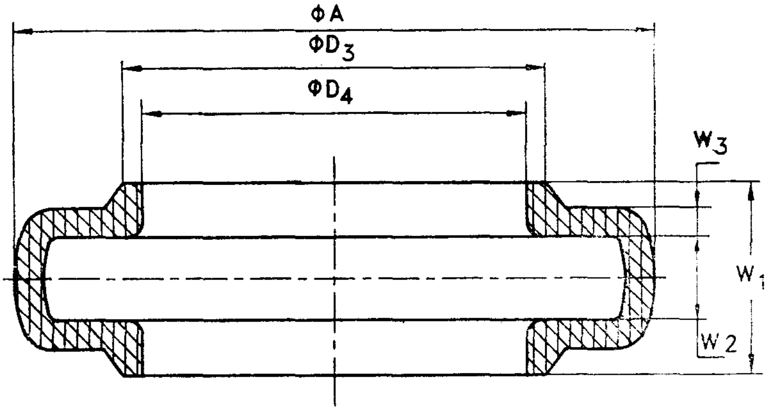
COUPLING DESIGNATION TC 359 TO TC 628

Coupling Design-ation	Rated Power kW/100 rev/min	Nominal Torque T_{KN} Nm	Maximum Torque $T_{K\max}$ Nm	Maximum Rotational Speed rev/min	Weight per Flange kg	Moment of Inertia kgm²	Bore		*A*	*B*	*C*	*D*	*L*
							Min	*Max*					
TC 104	0·22	21	64	4 500	1·60	0·00 074	11	30	104	02	—	22	66
TC 133	0·56	53	168	4 500	2·40	0·00 115	16	38	133	100	79	32	89
TC 165	1·11	106	318	4 000	4·00	0·00 520	16	48	165	125	73	38	109
TC 197	1·70	162	487	3 600	6·20	0·007	19	55	197	144	82	45	130
TC 211	2·65	253	759	3 100	9 80	0·010	25	65	211	167	95	51	145
TC 235	3·82	365	1 096	2 880	14·20	0·032	30	75	235	188	110	57	160
TC 254	5·29	505	1 517	2 600	19·00	0·055	35	85	254	216	124	60	168
TC 279	7·46	712	2 137	2 300	26·00	0·081	35	90	279	233	134	65	174
TC 314	12·40	1 182	3 547	2 050	33·00	0·137	38	102	314	264	152	76	201
TC 359	19·70	1 881	5 642	1 800	44·40	0·254	75	130	359	311	178	89	211
TC 402	32·60	3 113	9 339	1 680	71·68	0·469	75	140	402	345	187	102	234
TC 470	57·40	5 485	16 455	1 500	98·20	0·871	75	150	470	398	200	114	274
TC 508	97·60	9 325	23 508	1 300	116·20	1·301	80	150	508	429	200	114	276
TC 562	121·00	11 600	33 125	1 100	157·20	2·142	90	160	562	474	218	127	309
TC 628	154·00	14 675	42 740	1 000	208·00	3·505	100	190	628	532	254	132	323

Table 2 Dimensions of Tyre

(*Clause* 4.2)

All dimensions in millimetres.



Coupling Designation	A	D_3	D_4	W_1	W_2	W_3
TC 104	104	69	62	42	19	6·50
TC 133	133	77	71	49	22	8·00
TC 165	165	103	95	59	28	9·50
TC 197	197	118	107	66	35	9·50
TC 211	211	140	120	73	38	11·00
TC 235	235	159	146	77	41	11·00
TC 254	254	103	171	84	44	12·00
TC 279	279	194	102	80	40	13·00
TC 313	313	224	209	88	44	14·00
TC 359	359	280	265	110	57	16·50
TC 402	402	389	290	104	50	17·50
TC 470	470	309	330	127	68	19·00
TC 508	508	356	356	146	80	22·00
TC 562	562	380	394	161	86	26·00
TC 628	628	479	446	167	92	25·50

Table 3 Materials for Component Parts of Tyre Type Flexible Couplings

(*Clause* 5)

Sl No.	Component	Material	Requirement
i)	Coupling hub	Cast iron	Conforming to Grade FG 220 of IS 210 : 1993 Specification
		or	
		Cast steel	Grade 2 of IS 1030 : 1989
ii)	Pressure discs	Forged steel	25C4 of IS 1570 (Part 2/Sec 1) : 1979
		or	
		SG iron	SG 400/15 of IS 1865 : 1991
iii)	Fasteners:		
	a) Bolts and screws	—	Property class 8.8 as per IS 1364 (Part 1) : 1992 and IS 1364 (Part 2) : 1992
	b) Nut	—	Property class 8 as per IS 1364 (Part 3) : 1992
iv)	a) Tyre	Natural rubber	1) IHRD hardness : 70 ± 5° 2) Tensile strength : 12 MN/m^2 3) Elongation at break : 250% (*Max*) 4) Tear resistance of the compound : 75-85 N/mm^2 5) Specific gravity : 1·25 (*Max*) 6) Compression at 70°C and 72 h : 50% (*Max*) 7) Swelling property. When soaked in a mixture of equal volume of caster oil and purified diacetone alcohol at 70°C for 72 h. Volume change should not be more than —5 to +5% and hardness change: —5 IRHD. [For test method, *see* IS 3400 (Part 6) : 1983]
	b) Carcass	Rayon cord/Nylon	Cord construction : 2 × 1/1 650 Elongation at 4·5 kg : 1·5-2·5% Elongation at break : 11·2-13·2 % Breaking strength (kg) : 15·5 *Min* Cord Dia (mm) : 0·70-0·85 Volatile content : 5·0 % (*Max*) Adhesion strength (kg) : 8·0 (*Min*)

Table 4 Physical Properties of Tyres

(*Clause* 6)

Coupling Designation	Torsional Stiffness Nm/rad C_T	Maximum Parallelism Misalignment mm	Maximum End Float mm	Maximum Angular Misalignment deg	Alternating Torque T_{wi} @10 Hz ± Nm	Resonance Factor V_R	Damping Co-efficient
TC 104	5	1·1	1·3	4	11	7	0·9
TC 133	13	1·3	1·7	4	26	7	0·9
TC 165	26	1·6	2·0	4	53	7	0·9
TC 197	41	1·9	2·3	4	81	7	0·9
TC 211	63	2·1	2·6	4	127	7	0·9
TC 235	91	2·4	3·0	4	103	7	0·9
TC 254	126	2·6	3·3	4	252	7	0·9
TC 279	178	2·9	3·7	4	356	7	0·9
TC 313	296	3·2	4·0	4	591	7	0·9
TC 359	470	3·7	4·6	4	940	7	0·9
TC 402	778	4·2	5·3	4	1 556	7	0·9
TC 470	1 371	4·8	6·0	4	2 742	7	0·9
TC 508	1 959	5·3	6·6	4	3 918	7	0·9
TC 562	2 760	5·8	7·3	4	5 521	7	0·9
TC 628	3 562	6·6	8·2	4	7 124	7	0·9

ANNEX A

(*Foreword*)

GUIDELINES FOR DESIGN AND SELECTION OF COUPLING

A-1 COUPLING DESIGN AND SELECTION

The coupling may be designed in accordance with any one of the following three methods:

a) Approximate rough calculation based on the empirical values of the manufacturer, the calculation procedures and factors being taken from the manufacturer's catalogues;

b) Approximate rough calculations for the linear two-mass vibration generating system, using formulae listed in **A-4**; and

c) Higher order calculation methods.

A-2 COUPLING DESIGN BASED ON KNOWN PERFORMANCE CHARACTERISTICS

Couplings shall be so designed that the stresses occurring do not exceed the permissible values in any operating condition. When the coupling is the only torsionally flexible member, which is often the case, the machinery can be reduced to a two mass vibration generating system, in terms of torsional vibration. In this case, the coupling performance characteristics can be calculated using the equations given in **A-4** and in other cases, by way of a detailed vibration calculation.

A-3 COUPLING PERFORMANCE CHARACTERISTICS (*see* A-5 and A-6)

A-3.1 Nominal Torque of Machine (T_N)

Steady-state nominal torque at the coupling.

A-3.2 Peak Torque (T_S)

Maximum torque at the coupling.

A-3.3 Alternating Torque (T_{wi})

Amplitude of the *i*th harmonic of the torque acting on the coupling.

A-3.4 Damping Power (P_{wi})

Damping power arising from the *i*th harmonic of the torque acting on the coupling in the steady operating state.

A-3.5 Rotational Speed (n_N)

Rotational speed of coupling.

A-3.6 Stressing Frequency (f_i)

Frequency of the *i*th harmonic of the torque acting on the coupling.

A-3.7 Number of Starts (Z)

Number of starts per hour in the case of starts followed by brakings or in the case of reversals, Z is to be doubled.

A-3.8 Temperature (t)

Ambient temperature at the coupling during operation.

A-3.9 Axial Misalignment (ΔW_a)

Maximum axial displacement of shafts.

A-3.10 Radial Misalignment (ΔW_r)

Maximum radial displacement of shafts.

A-3.11 Angular Misalignment (ΔW_w)

Maximum angular displacement of shafts.

A-4 PERFORMANCE CHARACTERISTICS RELATING TO THE MACHINERY

A-4.1 Nominal Input Torque (T_{AN})

Nominal torque of driving machine calculated from the rated power and nominal rotational speed.

A-4.2 Nominal Output Torque (T_{LN})

Maximum value of output torque calculated from the power and rotational speed.

NOTE — T_l = output torque during acceleration.

A-4.3 Maximum Input Torque (T_{AS})

Peak value of the non-periodic, input torque impulses which can occur, for example, during start-up and during changes in rotational speed.

A-4.4 Maximum Output Torque (T_{LS})

Peak value of the non-periodic, input torque impulses which can occur, for example, during start-up and during changes in load and blocks.

A-4.5 Excitation Input Torque (T_{Ai})

Amplitude of the external torque excitation of the *i*th order acting on the driven end.

A-4.6 Excitation Output Torque (T_{Li})

Amplitude of the external torque excitation of the *i*th order acting on the driven end.

A-4.7 Impulse Time (t_0)

Duration of a square wave impulse.

A-4.8 Moment of Inertia at Drive End (I_A)

Sum of the moments of inertia at the drive end related to the rotational speed at the coupling.

A-4.9 Moment of Inertia at Driven End (I_L)

Sum of the moments of inertia present at the driven end related to the rotational speed at the coupling.

A-4.10 Mass Coefficient (m_C)

Ratio of drive end to driven end moments of inertia it is given by:

$$m_c = \frac{I_A}{I_L}$$

A-4.11 Resonance Frequency (f_e)

Resonance frequency of a linear two-mass vibration generating system. It is given by:

$$f_e = \frac{1}{2\pi}\sqrt{C_T\left(\frac{1}{I_A}+\frac{1}{I_L}\right)}$$

A-4.12 Impulse Coefficient (S_A/S_L)

The impulse coefficient is given by:

$$S_A/S_L = [\,1 - \cos(\,2\pi f_e \,.\, t_0\,)].$$

This formula applies to square-wave impulses (impulses as they occur in practice are not square-wave impulses).

The impulse coefficient, S_A/S_L, varies between 0 and 2.

For practical applications, S_A/S_L may be assumed to be approximately 1·8.

A-4.13 Torque Amplification Factor (V_{fi})

The torque amplification factor gives the amplification of the torque acting with the frequency f_i, it is given by:

$$V_{fi} = \sqrt{\frac{1+\frac{\psi^2}{4\pi^2}}{\left(1-\frac{f_i^2}{f_e^2}\right)^2+\frac{\psi^2}{4\pi^2}}}$$

A-4.14 Resonance Factor (V_R)

Factor as under **A-4.13** where $f_i = f_e$

$$V_R = \frac{2\pi}{\psi}$$

A-5 EQUATIONS FOR ROUGH CALCULATION OF COUPLING PERFORMANCE CHARACTERISTICS

Characteristic to be Calculated	*Equation*
T_N	$T_N = T_{AN}$ or $T_N = T_{LN}$
T_S	$T_S = T_{AS}\,[\,1/(\,m_C + 1\,)\,]\;S_A + T_L^{3)}$ or $T_S = T_{LS}\,[\,m_C/(\,m_C + 1\,)\,]\;S_L + T_L^{3)}$ $T_S = T_{Ai}\,[\,m_C/(\,m_C + 1\,)\,]\;V_R^{1)} + T_L^{3)}$ or $T_S = T_{Li}\,[\,m_C/(\,m_C + 1\,)\,]\;V_R^{1)} + T_L^{3)}$
T_{Wi}	$T_{Wi} = T_{Ai}\,[\,1/(\,m_C + 1\,)\,]\;V_{fi}^{2)}$ or $T_{Wi} = T_{Li}\,[\,m_C/(\,m_C + 1\,)\,]\;V_{fi}^{2)}$
P_{Wi}	$P_{Wi} = \pi/V_R\;[\,(\,T_{Wi}^2 \cdot f_i\,)/C_T\,]^{4)}$

NOTES

1 Because the calculation is based on full sharpness, the acceleration torque can be ignored.

2 These formulae only allow for the stress produced by one order of the excitation torque.

3 T_L shall only be added if a lead torque arises during the acceleration.

4 Simplified formula for usual values of V_R in the case of elastic rubber couplings.

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